SHORT COMMUNICATION

IMPULSE NOISE TRAUMA DURING ARMY WEAPON FIRING

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A 100 infanty personnel firing modern weapons such as the Anti Tank Guided Missile, 106mm Recoiless Gun (RCL), 84mm Rocket Launcher (RL) and 81mm Mortar were studied for the effect of impulse noise on the ear and the evolution of the Temporary Threshold Shift (TTS), Recovery Time (RT) and Permanent Threshold Shift (PTS) was traced.

Introduction

Aural trauma has been known for many centuries since the introduction of explosives and first documented by the French surgeon Ambroise Pare in the 16th century. Kramer in 1837 was the first to attribute sensorineural deafness as a possible sequel of blast trauma. Military service involves regular practice with weapons as a part of training. Most personnel are not aware of the hearing damage which occurs during their service tenure and the realization only comes when the deficit extends to the speech frequencies after many years of service.

Aim

The aim of this study was to evaluate the effect of acoustic trauma on the ear, by determining the amount of Temporary Threshold Shift, Recovery time and the Permanent Threshold Shift caused during routine practice with modern antitank weapons.

Material and Method

This study, was carried out at the Infantry School, Mhow between March 1993 and may 1994 by the Department of E.N.T., M.G.M. Medical College. The test group consisted of 100 infantry personnel, of varying age, service and rank, who first underwent a prefiring audiometry to establish an initial baseline. Individuals detected to have a conductive hearing loss were removed from the test group. The personnel then fired 2-4 rounds from the following weapons : 81 mm Mortar, 106mm Recoiless Gun (RCL), 84mm Rocket Launcher (RL) and the Anti Tank Guided Missle (ATGM), before the audiogram was taken. The post firing audiometries were then recorded serially from 5 mins after firing (at the firing range itself) till the high frequency average TTS reverted back to normal. If, however, the audiometry done in the 3rd week did not show reversal of the TTS, the deficit was declared as PTS. The time taken for the reversal of the TTS was the recovery time. The findings of the TTS, recovery time and PTS were correlated with age, service, weapon and ear affected.

Results

The age of the 100 personnel in the study group ranged from 19 years to 44 years with 74% being between 21 to 30 years (Table No. I). 58% had service of 1 to 5 years and 18% of 6 to 10 years.

Table 1
Age Distribution of the study group

Age (yrs)	No. of Cases	No. of Ears	Percentage
16–20	1	2	1
21–25	53	106	53
26–30	21	42	21
31–35	13	26	13
36–40	4	8	4
41-45	8	16	8
46–50	0	0	0
Total	100	200	100

The first postfiring audiometry revealed that all the individuals showed a high frequency loss of

varying degrees. The postfiring Air Conduction thresholds showed the highest incidence of hearing loss between 55-75 dBs (68%), the next highest being at 80-95 dBs comprising of 17.5% of the ears. The maximum loss recorded for the right ear was in the region of 86-90 dBs, while for the left it was 91-95 dBs. Overall there was an approximate 5-10 dB difference between the two ears with the left ear showing more loss. The Air Conduction thresholds correlated with age showed that in the age group 21-25 years the maximum incidence of hearing loss was 49.1% between 61-70 dB and in the age of 41-45, the maximum incidence of hearing loss was 56.3% between 81-90 dB.

In this study the high frequency average TTS was found to be maximum between 46-55 dB (57%) for the right ear and between 51-60 dB (63%) for the left ear. The maximum TTS recorded for the right was 65 dB, while for the left it was 75 dB. The TTS correlated with age revealed that the younger groups fared better having maximum incidence of TTS for both ears between 46-55 dB (60%). In the older age group of 36 to 40 years maximum incidence occurred between 56-65 dB (87.5%).

The recovery period for the TTS was within 6 hours for 61% of the ears, within 24 hours for 78.5% of the ears, within 3 weeks for 90.5% of the ears (Table No. II). There was subsequently no further recovery and at the end of 3 weeks, the remainder 9.5% of the ears were declared to have developed a PTS. Correlated with age, the recovery time findings revealed that in the age group of less than 25 years, 90.7% recovered within 24 hours. This is in sharp contrast to the older age group of above 30 where only 44% recovered within 24 hours.

Table 2

Recovery time of TTS correlated with time and age

Age (yrs) Decibels	16-20 yrs	21-25 yrs	26-30 yrs	31-35 yrs	36-40 yrs	41-45 yrs	Percent
2 hours	0	42	4	0	0	2	24.0
6 hours	2	46	18	8	0	0	37.0
24 hours	0	8	15	6	2	4	17.5
1 week	0	6	5	9	0	4	12.0
>3 weeks	0	4	0	3	6	6	9.5
Table	2	106	42	26	8	16	100%

In the younger age group of 21-25, four ears developed PTS, a percentage of 3.8%. In the older age group of 36 years and above, 12 out of 24 ears showed PTS, a percentage of 50%. The magnitude of the PTS was 20 dB maximum with 6-10 dB being the maximum incidence (52.7%).

Discussion

The age and service of the study group were closely related to each other, as a person who was older in age had more service. The Air Conduction thresholds showed that there was a definite increase in the hearing loss as the age and service increased. For the right ear, in the age group 21-25 years the maximum incidence of hearing loss occurred between 56-65 dBs, whereas in the age group of 41-45, maximum hearing loss was between 81-90 dB. Similarly for the left ear, maximum personnel in the age group of 21-25 years had hearing loss between 61-70 dBs, where as most personnel in the age group of 41-45 years had hearing loss between 86-95 dBs.

In this study the high frequency average TTS was found to be maximum between 48-55 dB (57%) for the right ear and between 51-60 dB (63%) for the left ear. The maximum TTS recorded for the right was 65 dB, while for the left it was 75 dB. Though there was a difference and asymmetry of hearing loss seen between both the ears, it was not classically due to the 'head shadow effect', which has an attenuating effect of 20 dB on the right ear and has been specifically noticed in regard to weapons and shotguns fired from the shoulder. Weapons fired from the hip or held in front like the sten gun or pistol failed to give this effect. In this study though there was a difference and asymmetry noted in the ears, it was only 5-10 dBs in magnitude and was not seen in all the cases. This is probably due to the peculiarities of the weapons fired such as a significant backblast, sideways position of the firer in order to escape the backblast and also due to the fact that the firing occurred in groups of 4 to 5 guns in a row, therefore, exposing the firer simultaneously to the impulse trauma of the adjoining guns.

When the hearing loss was compared to weapons, no individual firing an ATGM had a hearing loss more than 70 dB, with 75% of the ears have a hearing loss within 65 dB. In

individuals firing the other weapons, 41.2 % of the ears had a hearing loss more than 70 dB. Personnel firing the other three weapons revealed a similar pattern of hearing loss being of the maximum magnitude of 90 to 95 dB. The fact that the personnel firing the ATGM suffered the least loss is mainly due to the lesser number of rounds fired by each and partly due to the wearing of the headphones as it gave a protection to the extent of 12.2 dB.

As the observations show there is an increase in the incidence and severity of the hearing loss in the test group in individuals who had service more than 10 years. The firing produced PTS mainly in the older age group and in those individuals who were susceptible to impulse trauma. In the younger age groups the isolated cases of a large TTS is probably attributable to individual susceptibility. It is well documented that there is a marked individual variation in the susceptibility to the effects of acoustic trauma. In literature there have been described tough ears which can withstand higher levels of exposure and tender ears which are easily damaged by noise.

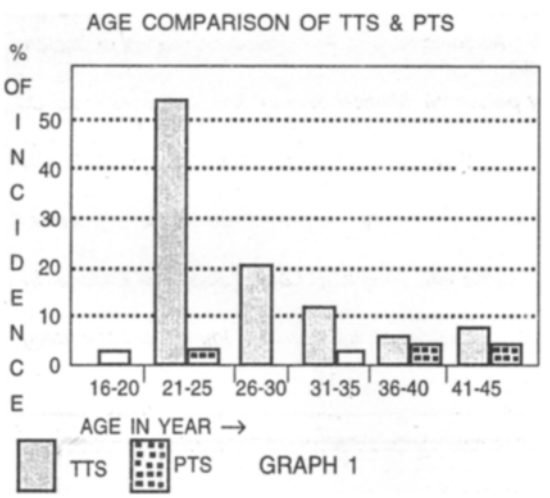

Fig. 1 :

Correlated with age, the recovery time findings revealed that in the age group of less than 25 years 90.7% recovered within 24 hours. This is in sharp contrast to the older age group of above 30 years where only 44% recovered within 24 hours. Pfander (1987) stated that TTS upto 30 minutes is universal and to be regarded as harmless. Recovery time between 3 to 12 hours is to be regarded suspicously and recovery time more than 12 hours implies that there may be some inner ear damage. Pfander (1987) also found that

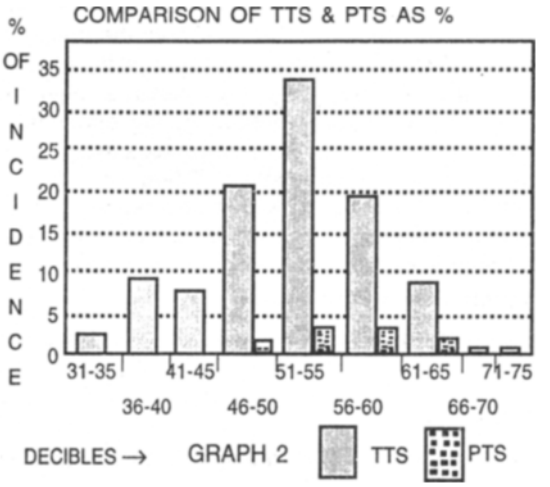

Fig. 2 :

on an average 6% of personnel firing unspecified weapons have a recovery period more than 24 hours while in this study it was 21.5%.

In this study the total incidence of PTS was 9.5%. correlated with age, in the younger age group of 21-25, 3.8% developed PTS, while in the older age group of 36 years and above, 50% showed PTS. There are two different modalities to the development of a PTS. Firstly, the sudden development of PTS after exposure to a blast trauma. The second method of evolution of the PTS is a slow progressive loss due to repeated acoustic trauma which leads to a progressive increase in the Recovery Time which finally blends into PTS.

Forrest (1973) also stated that it is difficult to establish a quantitative relationship between military impulse noise and the hearing loss due to the fact that military impulse noise exposure occurs irregularly and previous exposures are difficult to estimate. In addition gun crews are also exposed to noise from the adjoining guns if firing simultaneously. All individuals fire several times a year throughout their service tenure from the day of their recruitment. Thus it is very difficult to attribute the hearing loss in soldiers due to any particular firing episode or weapon.

During actual combat and also during practice firing the communication between the leader and

the firer is of paramount importance due to safety reasons. The communication along with ear protectors is frequently questioned by the Army personnel because of two main reasons, which are: Firstly, if both individuals are wearing ear protectors than they tend to speak in a low intensity as the ear protector masks the ambient noise. Secondly, when a person with a pre-existing high frequency loss uses a hearing protector, which also predominantly attenuates high frequencies there is a precipitous drop in the high frequency thresholds. There is also a simultaneous and significant decrease in the speech reception threshold causing a real problem in communication in these cases.

Conclusion and Summary

Repeated exposure to impulse noise results initially in audiotory fatigue, followed by prolongation of the recovery time, leading to Long Term TTS, which again if subjected to acoustic trauma becomes PTS. This is well seen in this study, where older individuals with longer service had a longer recovery period and more incidence of PTS, which was seen in the firing of all the weapons, except ATGM firers whose number were too less to make any accurate distinction.

Good hearing is absolutely essential for troops in combat, as soldiers in actual fighting or patrol duties have not only to hear the orders of their commanders but also have to be extremely vigilant of the faintest warning sounds of the enemy. It is, thus important to prevent acoustic trauma during peace time practices by the use of ear protectors which should be widely used.

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Congratulation !

Dr. Karan Sharma, Senior Lecturer. Dept. of ENT, Govt. Medical College, Amritsar, has received the Govt. Fellowship award '96 being bestowed on him by Govt of Japan National Rehabilitation Centre for the disabled and Shimizu Foundation for Social Welfare and Otolaryngology Department of Teikyo University, Tokyo.